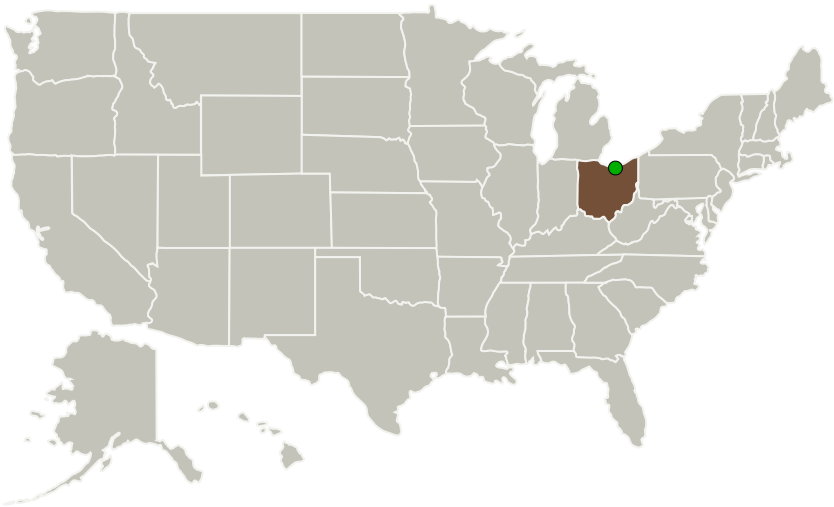
Characterization and Modeling of Residual Stress and Cold Work Evolution in PM Nickel Base Disk Superalloy, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

Powder metal (PM) superalloys used for critical compressor and turbine disk applications are prone to fatigue failures in stress concentration features such as holes and radii, as well as from corrosion pits and inclusions. Residual stress and cold work will have a dramatic impact on the fatigue performance. Shot peening is widely used on PM disks to provide a fatigue benefit however, the relaxation due to thermal and mechanical loads can reduce or even eliminate the compressive residual stresses and increase the risk of a catastrophic disk failure. Up to now the evolution of the residual stress and cold work under typical operating conditions in PM disk superalloys is not well understood. In Phase I proprietary x-ray diffraction (XRD) techniques will be used to simultaneously measure the change in residual stress and cold work for fatigue specimens tested in a manner to approximate in-service conditions. XRD residual stress and cold work results will be used to establish the feasibility of applying analytical or empirically based modeling techniques to predict the residual stress and cold work evolution. The modeling technique will first be demonstrated on fatigue samples and further developed and proven on actual disk hardware in Phase II. The anticipated beginning and ending technology readiness levels (TRLs) for Phase I are 2 and 5, respectively.

Primary U.S. Work Locations and Key Partners



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Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
Lambda Research	Lead Organization	Industry	Cincinnati, Ohio
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations
Ohio

Project Transitions

February 2011: Project Start

August 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138032)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Lambda Research

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

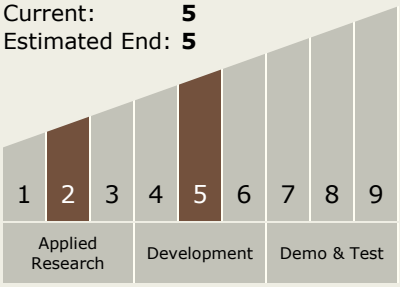
Carlos Torrez

Principal Investigator:

Douglas Hornbach

Technology Maturity (TRL)

Start: **2**
Current: **5**
Estimated End: **5**



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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System